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TECHNICAL MEMORANDUM

USER'S GUIDE FOR MULTI-BASIN ROUTING MODEL

by

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EXECUTIVE SUMMARY

The volume and complexity of surface water management systems for which permits are sought from the South Florida Water Management District (District) have brought about the need to improve the District's flood routing analysis abilities. Routing models previously used by the District's permitting staff were capable of analysing only one basin at a time. Analysis of multiple cascading basins, inter-connected by multiple discharge structures was therefore cumbersome and time consuming. A multi-basin routing model has been developed for analysis of water management systems. The model is available on the District's main frame computer (CYBER-180) as well as on the IBM personal computer (PC). This report gives a general overview of how the model works and a comprehensive guide to the application of the model.

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INTRODUCTION

The influx of surface water management permit applications to the South Florida Water Management District (District) has increased steadily since the regulatory program began in 1972. The complexity of the surface water management system designs has also increased to meet more detailed design criteria. The ever-present requirement for expeditious as well as sophisticated analyses has necessitated improvement to the District's flood routing analysis capabilities.

Routing models previously used by the District's permitting staff were capable of analysing only one basin at a time. Simulation of multiple cascading basins connected by multiple discharge structures was cumbersome and time consuming.

This report presents documentation for the Multi-Basin Routing (MBR) model, a computer routing model designed to give the user a convenient means of analyzing more complex water management system designs. The MBR model has been in limited use by the Surface Water Management Division staff for several months. During this time, debugging and modification of the model has continued. A number of changes have been incorporated to accommodate the staff's needs. While each change has increased the capabilities of the model, they have collectively made data entry more lengthy and time consuming. Accordingly, future changes may be implemented through separate versions of the model designed to handle specific situations.

The primary purpose of this report is to provide a concise overview of how the model works and a comprehensive guide to application of the model. The main body of this report is divided into five sections. The first section presents an overview of the model capabilities and methods used for solving various problems. Descriptions of methods are not intended to be exhaustive but sources and references are provided where appropriate. The second, third and fourth sections give detailed explanations of the required model inputs, model results and instructions for running the model. The final section describes features expected to be included in future versions of the model. An example illustrating use of the model, and model results is presented in the Appendices.

The model is set up to run either on the District's main frame computer (CYBER-180) or on an IBM personal computer (PC). Both versions of the model are essentially the same. Minor differences are pointed out in the User's Guide.

OVERVIEW

The MBR model is a hydrologic/hydraulic routing model which routes storm runoff through a maximum of thirty basins, connected in series or parallel, to a final outfall. The model can handle flow through one or more discharge controlling structure for each basin. A maximum of thirty structures is allowed for the entire system.

Runoff from a specified storm in each basin is generated using the District's modification of the Santa Barbara Urban Hydrograph (SBUH) method [2]. The SBUH computations require specifications of rainfall amount, duration and distribution type as well as average basin soil storage and time of concentration for each basin. The user is allowed to select one of four rainfall distribution types:

the SFWMD one day distribution

the SFWMD three day distribution

the SFWMD five day distribution

the Orange County distribution

The SFWMD rainfall distributions are described in the District's permit information manual, Volume IV [3]. The Orange County distribution is based on a one day distribution established by that county.

At each time step the model computes the rate and direction of flow through each basin discharge structure, based on relative water elevations (stages) in adjacent basins and then updates stages in the basins based on computed runoff and flows to and from other basins.

Basin discharge structures can be either a pump or any combination of a single weir, orifice and pipe. A choice of sharp-crested or broad crested weir is provided. The model can also handle drop-inlet (or *Morning Glory*) type weirs. The user is allowed to specify a circular or rectangular orifice, or V-notch type bleeder.

Structure discharges are computed using the appropriate weir, orifice or pipe flow formulae based on the upstream and downstream stages.

Flow over a sharp-crested weir is computed using the following formulae:

$$Q = C\ L\ H^{1.5} \qquad \text{for horizontal crest} \qquad (1)$$

$$Q = 2.5\ tan\ (\theta/2)\ H^{2.5} \qquad \text{for V-notch weir} \qquad (2)$$

where, Q is the time discharge rate over the weir (cfs)

C is the weir coefficient (equals 3.13 for sharp crested weirs)

L is the length of weir crest (ft)

H is the head over the weir (ft)

θ is the angle of the V-notch

For submerged flow,

$$Q_s / Q = (1 - (H_2/H_1)^n)^{0.385} \qquad (3)$$

where, n = 1.5 for horizontal crest and

n = 2.5 for V-notch weir

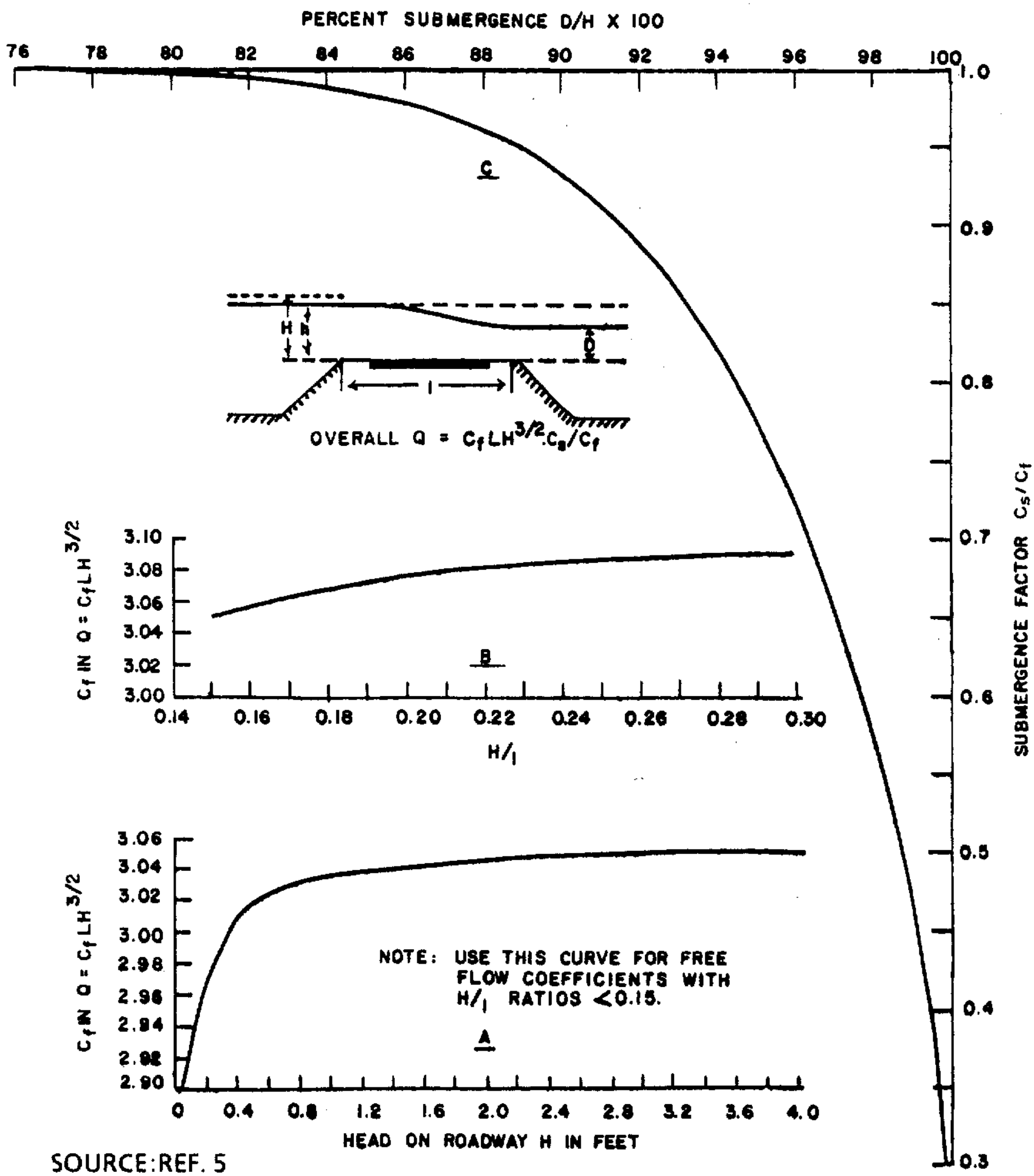
Q_s is the discharge rate over a submerged weir

H_1 is the upstream head over the weir crest, or V-notch invert

H_2 is the downstream head over the weir crest, or V-notch invert

Equation (1) is a general weir equation which also applies to broad-crested and drop-inlet type weirs. When a broad-crested weir is specified, the weir coefficient, C, must also be specified for use in equation (1). Curves of recommended weir coefficients under different flow conditions are given in Figure 1 [5]. The effects of

Figure 1. DISCHARGE COEFFICIENTS FOR LIMITING WEIR FLOW OVER BARRIERS



SOURCE: REF. 5

submergence on flow over a broad-crested weir are determined with the use of curves developed by the Federal Highway Administration [5] which are also given in Figure 1.

Weir coefficients, C, for drop-inlet type weirs are determined from empirical design curves developed by the Bureau of Reclamation [4]. See Figure 2. Values of C for the drop-inlet type weir are dependent on the ratio of head over the crest to radius of weir crest (H_0/Rs) and vary to reflect different conditions of flow, for example, submerged flow. When H_0/R_s exceeds 2.0, the model assigns a C value of 1.0. When H_0/R_s is less than 0.2, the model assigns a C value of 4.0.

Flow through bleeders is computed using the formula:

$$Q = 0.6\, A\, (2\, g\, H)^{.5} \tag{4}$$

where, A is the orifice area (sq ft)

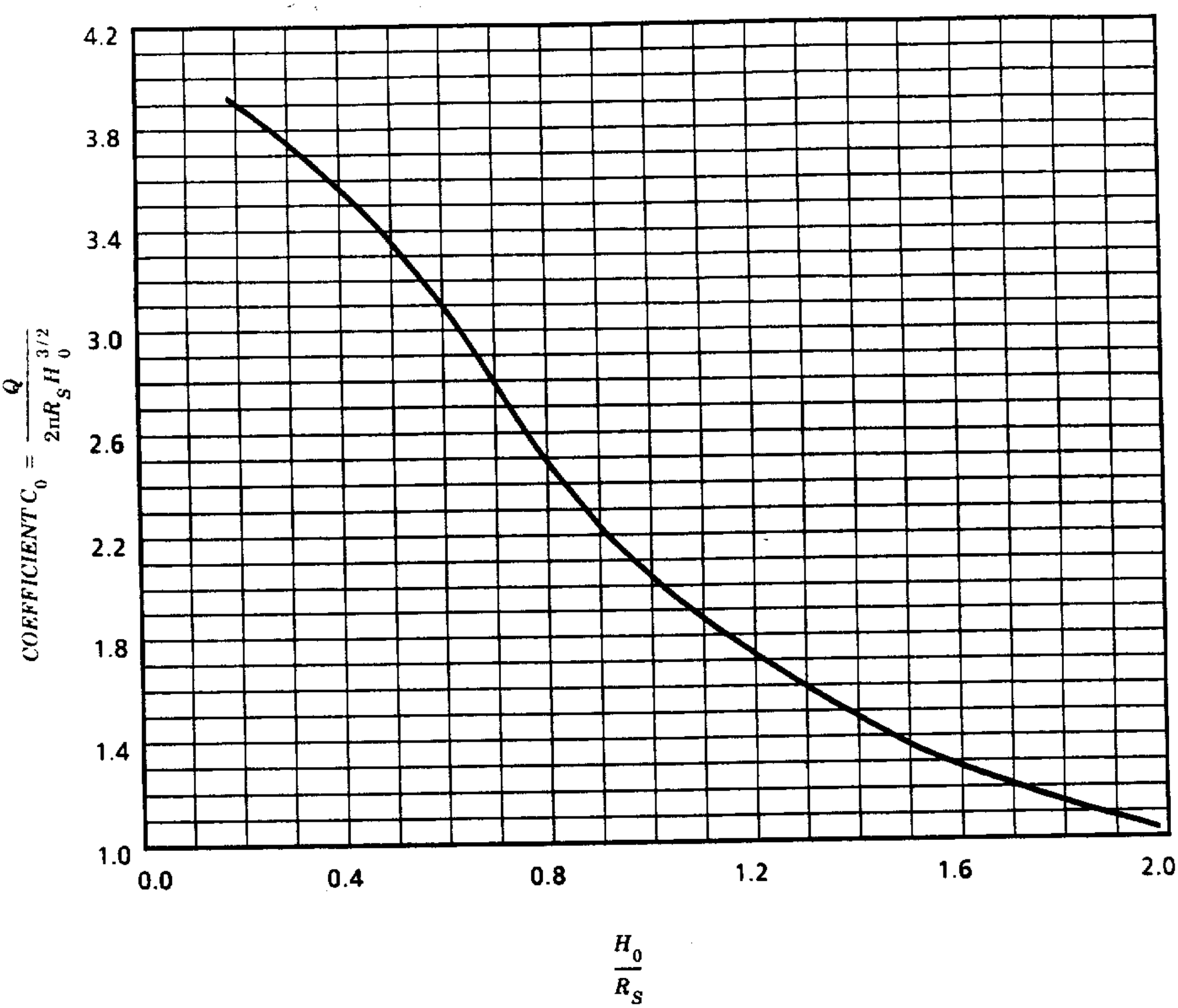
g is gravitational acceleration (ft/sec^2)

H is the head above the centroid of the orifice (ft)

Bleeders are treated as weirs until the headwater submerges the orifice. The model can handle rectangular and circular orifices.

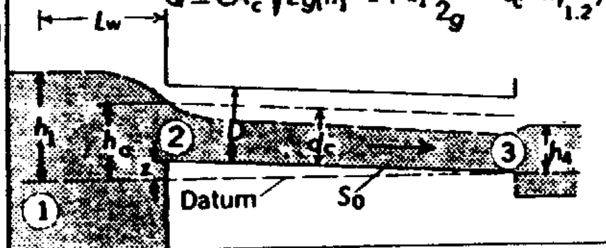
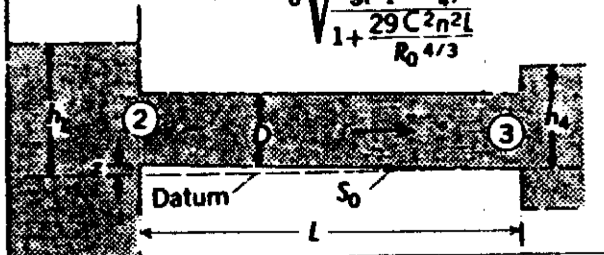
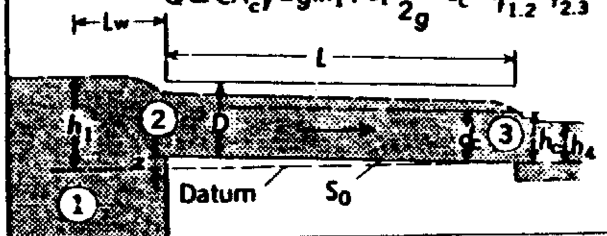
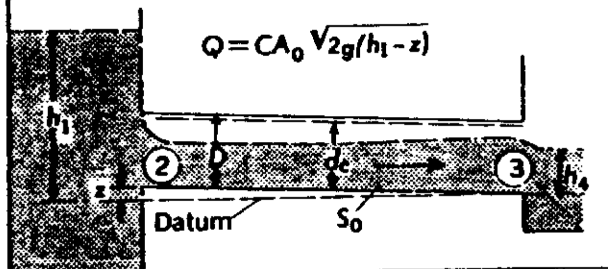
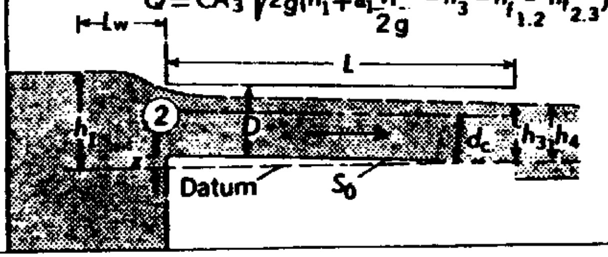
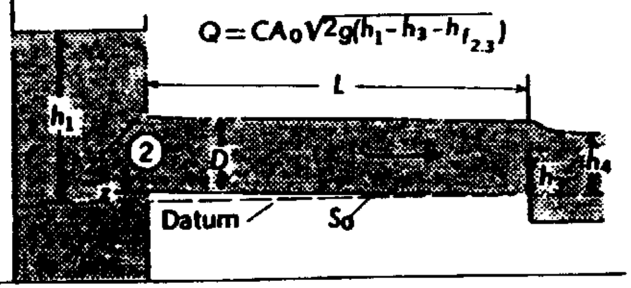
Circular pipe flow is computed using six categories of pipe flow defined by the United States Geological Survey [1]. Pipe flow is characterised by the upstream and downstream invert elevations and the head and tailwater elevations at the time of flow. The six types of flow are shown in Figure 3. For details of pipe flow computations, see Bodhaine (1968) [1].

Figure 2. RELATIONSHIP OF WEIR COEFFICIENT C_0 TO H_0/R_S FOR DROP INLET TYPE WEIRS



SOURCE:REF. 4

Figure 3. CLASSIFICATION OF PIPE FLOW

TYPE	EXAMPLE	TYPE	EXAMPLE
1 CRITICAL DEPTH AT INLET $\frac{h_1 - z}{D} < 1.5$ $h_4/h_c < 1.0$ $S_0 > S_c$	$Q = CA_c\sqrt{2g\left(h_1 - z + \alpha_1\frac{V_1^2}{2g} - d_c - h_{f_{1.2}}\right)}$  	4 SUBMERGED OUTLET $\frac{h_1 - z}{D} > 1.0$ $h_4/D > 1.0$	$Q = CA_0\sqrt{\frac{2g(h_1 - h_4)}{1+\frac{29C^2n^2L}{R_0^{4/3}}}}$ 
2 CRITICAL DEPTH AT OUTLET $\frac{h_1 - z}{D} < 1.5$ $h_4/h_c < 1.0$ $S_0 < S_c$	$Q = CA_c\sqrt{2g\left(h_1 + \alpha_1\frac{V_1^2}{2g} - d_c - h_{f_{1.2}} - h_{f_{2.3}}\right)}$  	5 RAPID FLOW AT INLET $\frac{h_1 - z}{D} \geqq 1.5$ $h_4/D \leqq 1.0$	$Q = CA_0\sqrt{2g(h_1 - z)}$ 
3 TRANQUIL FLOW THROUGHOUT $\frac{h_1 - z}{D} < 1.5$ $h_4/D \leqq 1.0$ $h_4/h_c > 1.0$	$Q = CA_3\sqrt{2g\left(h_1 + \alpha_1\frac{V_1^2}{2g} - h_3 - h_{f_{1.2}} - h_{f_{2.3}}\right)}$  	6 FULL FLOW FREE OUTFALL $\frac{h_1 - z}{D} \geqq 1.5$ $h_4/D \leqq 1.0$	$Q = CA_0\sqrt{2g(h_1 - h_3 - h_{f_{2.3}})}$ 

SOURCE: REF 1

In the case of composite structures, that is, where structures consist of weir and/or bleeder combinations with pipes, interactions between the elements of the structure are taken into account when the structure flow is determined. For example, in the case of combined weir and pipe flow in a riser pipe structure, the tailwater elevation of the weir should be the headwater elevation used in the computation of pipe flow. The CYBER version of the MBR model handles composite structures iteratively, in which the pipe and weir flows are computed and adjusted until the elevations of weir tailwater and pipe headwater are the same. The result is a computed pipe flow that is equal to the weir/bleeder flow with the weir/bleeder tailwater stage equal to the pipe headwater stage. The flow is pipe controlled when the pipe's headwater rises above the weir crest or orifice centroid. This iterataive approach is computationally time intensive and run times can be very long, particularly when the model is to be run on a PC. The iterative approach was, therefore, not used in the PC version. The PC version of the model applies the head and tailwater elevations of the composite structure to determine both weir and pipe flows. Pipe controlled flow (i.e., flow in which the pipe's existence affects the weir/bleeder discharge) is then assumed when the computed pipe flow is less than the computed flow through the weir/bleeder and weir controlled flow is assumed when the weir flow is less than pipe flow. In either case, flow through the controlling component is taken as the flow through the composite structure. While the treatment of composite structures in the CYBER version is more realistic, the resultant error in the PC version is generally less than 15%.

The model treatment of reversed flow through composite structures is not entirely correct. While the direction of flow is reversed, the elements of the structure are also reversed. This is not expected to affect most analyses performed using the model, since incidence of reversed flow through composite structures is uncommon and the resulting error is expected to be small.

The off-site stage (or system outfall tailwater) can be specified in the model as either a constant stage or a time varying stage. The latter capability allows the user to simulate the effects of routed flood waves or tidal variations in the receiving waters, where such information is available.

The MBR model keeps an account of total discharge and total inflow through each basin structure so that conservation of mass can be verified.

INPUT DATA

Input to the MBR model is accomplished using a data file which can be created by a user friendly interactive data entry program. During the interactive session, the user is asked a series of questions about the design storm, the basin hydrology, basin discharge structures and downstream receiving waters. Table 1 describes the MBR model's data requirements, and the general order in which the model asks for the information. An example of an interactive session is presented in Appendix A.

Once the interactive session is completed, the model can be run either immediately or at a later date. The input data file can be saved and modified for subsequent model runs. Modifications to the data file are accomplished on the CYBER using the line editor, XEDIT, or on the PC using either SPF/PC or some other text editor. An output file (runfile) is created during the interactive data entry session which records all exchanges between the model and the user. This runfile is very useful for checking input data and for modifying the input data file.

Table 1. Specific data required for execution of the Multi-Basin Routing Model. Items are presented in the same order in which they are entered into the model.

CATEGORY	DESCRIPTION
General Information	• name of the reviewer • name of the project • a project identification number; e.g., permit number
General Basin Information	• number of basins within the project • termination discharge, cfs • basin number for which the termination discharge applies. The model will stop execution when the total outflow from this basin is below the termination discharge.
For Each Basin	• area, acres • available ground storage, inches • time of concentration, hours • a set of points describing the stage-storage relation of the basin, i.e., the volume, in acre-feet, contained in the basin when the water level is at a given stage, in feet.
Design Rainfall Information	• design rainfall frequency, in years • the 24-hour design rainfall depth, inches • The design rainfall distribution type, as selected by one of the following numbers: 1 - SCS Type I distribution 24 hour duration 3 - SCS Type III distribution 3 day duration 5 - SCS Type III distribution 5 day duration 6 - Orange County distribution 24 hour duration
Reporting time step	• the time step at which model results are posted to an output file
Structure information	• number of structures
For Each Structure	• type of structure: pump pipe (circular culverts) weir bleeder *Note: The "pump" structure is exclusive of all the other structure types, that is a structure cannot have a "pump" and "pipe" at the same time. However, a structure may be any combination of "pipe", "weir", or "bleeder".*
Pump Information	• stage at which the pump turns ON, feet • stage at which the pump turns OFF, feet • pump discharge capacity, cfs or gpm

Pipe Information	• diameter, feet • Manning's roughness coefficient • pipe length, feet • headwater invert elevation, feet • tailwater invert elevation, feet
Weir Information	• weir type, which is limited to 1. broad crested weir 2. sharp crested weir 3. circular inlet drop structure • weir crest elevation, feet • weir length - broad or sharp crested weirs • inlet radius - circular inlet type • discharge coefficient - broad crested weirs only
Bleeder Information	• bleeder type, which is limited to 1. inverted triangle (V-notch) 2. circular 3. rectangular • centroid elevation (notch elevation of inverted triangle), feet • bleeder dimensions: 1. inverted triangle: notch angle, in degrees, and top elevation feet. 2. circular: radius, in feet 3. rectangular: length, in feet, and width, in feet
Upstream Basin	• number of the basin from which the structure discharges
Downstream Basin	• number of the basin to which the structure discharges (if the structure discharges "offsite" the downstream basin number is the number of basins plus one.
Offs ite Stage Information	• a set of time (hours) and stage (feet) points for the offsite area. The offsite stage can effect the flow through from structures which discharge offsite.

OUTPUT

An example output data file is presented in Appendix B. This file was created during a model run using the input data presented in Appendix A. The first section contains a summary of input data; basin and structure characteristics, and offsite conditions. The second section headed "SUMMARY REPORT" lists for each time step,cumulative rainfall, cumulative runoff, instantaneous runoff and runoff hydrograph for each basin and the rate of discharge for each structure. The conditions of flow are also listed eg., NO FLOW, PUMP, BLEEDER.

The final section gives the peak discharge, time of peak discharge, the peak stage and time of peak stage for each structure, the total inflow, outflow and runoff, final stage and storage for each basin. The inflow, outflow and runoff, and storage values can be used to check mass balance in each basin. For example, the total outflow should be equal to total inflow plus runoff, minus storage for mass balance within a basin.

The PC version of the model allows the user to plot computed stages and total outflows vs. time for any selected basin. The plot routine uses SYMPHONY graphics and the user must have a version of SYMPHONY on his/her PC and have familiarity with it. These plots are useful for checking and interpreting the model output. Example plots are included in Appendix B. The plots are best previewed on an Enhanced Color Display monitor.

INSTRUCTIONS FOR RUNNING THE MODEL

Instructions for running the model are different for the CYBER and the PC. They will therefore be discussed separately.

CYBER Instructions

Before running the model on the CYBER, the user must get the procedure file from the systems library by typing:

/ GET, PROCFIL/UN=SWLIB

The execution statement for the model is then:

/ - MBRMOD

The user is first asked to select which version of the model to use: the "composite structure" version, or the normal version. The normal version will be faster; the composite structure version will be more accurate. The user is then prompted for input and output file names. These files will be local upon model completion. An option is also available for printing a record of the interactive session.

PC Instructions

The first step is to get into the sub-directory called MBRDIR in which the input/output data files are stored. i.e., type:

> CD/MBRDIR

If this sub-directory does not exist it will have to be created. i.e., type:

> MD/MBRDIR

All MBR model runs should be done from within this sub-directory. The compiled version of the model is provided on a diskette. This diskette must be inserted in the 'A' drive before running the model.

Instructions for running the model can then be printed on the screen by typing:

> A : HELP

Appendix C gives a listing of these instructions which are clear and self-explanatory. Appendix C also contains detailed instructions for plotting the results of the model. Plotting instructions can be printed on the screen by typing:

> A : HELPLOT

FUTURE VERSIONS OF THE MODEL

Work on the MBR model is continuing and future versions of the model are expected to include

a) a more convenient means of entering input data,

b) channel routing capabilities using some existing channel routing program.

Additional changes to the model will be included in later versions, as the need arises.

REFERENCES

1. Bodhaine, G.L. 1968. Measurement of Peak Discharge at Culverts by Indirect Methods. United States Geological Survey, TWI 3-A3.
2. Hall, Charles Alan. 1981. Finally! An Easy Hydrograph Computation Method. South Florida Water Management District.
3. South Florida Water Management District. 1987. Management and Storage of Surface Waters, Permit Information Manual Volume IV.
4. United States Department of the Interior, Bureau of Reclamation. 1973. Design of Small Dams.
5. United States Department of Transportation, Federal Highway Administration. 1978. Hydraulics of Bridge Waterways, Hydraulic Design Series No. 1.

APPPENDIX A

EXAMPLE INTERACTIVE DATA ENTRY SESSION

```
ENTER REVIEWER NAME(        )
 CHINFATT
ENTER PROJECT NAME(        )
 CHIPCO GROVE
ENTER PROJECT IDENTIFICATION NUMBER
 2257
ENTER NUMBER OF BASINS (NOT EXCEEDING 30)
2
ENTER TERMINATION DISCHARGE (    .0 CFS)
AND THE SELEECTED BASIN NO.(  0)
NOTE: THE BASIN SELECTED TO CONTROL THE COMPLETION OF
      ROUTING CAN BE ANY OF THE PROJECT BASINS

1.8 2
********************* BASIN  1 ********************
 ENTER BASIN AREA (     .0 ACRES)
 66.4
 ENTER GROUND STORAGE (     .0 INCHES)
 .5
 ENTER TIME OF CONCENTRATION (   .0 HOURS)
 .7
********************* BASIN  2 ********************
 ENTER BASIN AREA (     .0 ACRES)
 12.
 ENTER GROUND STORAGE (     .0 INCHES)
 .01
 ENTER TIME OF CONCENTRATION (   .0 HOURS)
 .7
 DO YOU NEED TO CORRECT LEGEND INFORMATION?
 1=YES  2=NO
 2.
 BASIN NO.  1
 POINT NO.   1
 ENTER STAGE (     .0 FT) ,STORAGE (     .0 AC-FT)
 NOTE: ENTER 0,0 TO FINISH STAGE/STORAGE FOR EACH BASIN
 17. 0.
 BASIN NO.  1
 POINT NO.   2
 ENTER STAGE (     .0 FT) ,STORAGE (     .0 AC-FT)
 NOTE: ENTER 0,0 TO FINISH STAGE/STORAGE FOR EACH BASIN
 19. 4.
 BASIN NO.  1
 POINT NO.   3
 ENTER STAGE (     .0 FT) ,STORAGE (     .0 AC-FT)
 NOTE: ENTER 0,0 TO FINISH STAGE/STORAGE FOR EACH BASIN
 20. 12.6
 BASIN NO.  1
 POINT NO.   4
 ENTER STAGE (     .0 FT) ,STORAGE (     .0 AC-FT)
 NOTE: ENTER 0,0 TO FINISH STAGE/STORAGE FOR EACH BASIN
 22. 140.4
 BASIN NO.  1
 POINT NO.   5
```

```
ENTER STAGE (     .0 FT) ,STORAGE (     .0 AC-FT)
NOTE: ENTER 0,0 TO FINISH STAGE/STORAGE FOR EACH BASIN
0. 0.
BASIN NO.  2
POINT NO.   1
ENTER STAGE (     .0 FT) ,STORAGE (     .0 AC-FT)
NOTE: ENTER 0,0 TO FINISH STAGE/STORAGE FOR EACH BASIN
20.1 0.
BASIN NO.  2
POINT NO.   2
ENTER STAGE (     .0 FT) ,STORAGE (     .0 AC-FT)
NOTE: ENTER 0,0 TO FINISH STAGE/STORAGE FOR EACH BASIN
21.1 10.
BASIN NO.  2
POINT NO.   3
ENTER STAGE (     .0 FT) ,STORAGE (     .0 AC-FT)
NOTE: ENTER 0,0 TO FINISH STAGE/STORAGE FOR EACH BASIN
22.1 22.
BASIN NO.  2
POINT NO.   4
ENTER STAGE (     .0 FT) ,STORAGE (     .0 AC-FT)
NOTE: ENTER 0,0 TO FINISH STAGE/STORAGE FOR EACH BASIN
23.1 34.
BASIN NO.  2
POINT NO.   5
ENTER STAGE (     .0 FT) ,STORAGE (     .0 AC-FT)
NOTE: ENTER 0,0 TO FINISH STAGE/STORAGE FOR EACH BASIN
24.1 46.
BASIN NO.  2
POINT NO.   6
ENTER STAGE (     .0 FT) ,STORAGE (     .0 AC-FT)
NOTE: ENTER 0,0 TO FINISH STAGE/STORAGE FOR EACH BASIN
25.1 58.
BASIN NO.  2
POINT NO.   7
ENTER STAGE (     .0 FT) ,STORAGE (     .0 AC-FT)
NOTE: ENTER 0,0 TO FINISH STAGE/STORAGE FOR EACH BASIN
0. 0.
DO YOU NEED TO CORRECT STAGE STORAGE CURVE
1-YES  2-NO
2.
ENTER DESIGN FREQUENCY IN YEARS
25.
ENTER RAINFALL DISTRIBUTION TYPE
1 = 24-HOUR
3 = 3-DAY
5 = 5-DAY
3
ENTER 24-HOUR RAINFALL AMOUNT IN INCHES
8.8
DO YOU NEED TO CORRECT RAINFALL INFORMATION?
1=YES  2=NO
2.
ENTER INCREMENTAL STEP (   .0 HOURS)
```

```
4.
ENTER NUMBER OF STRUCTURES [NOT EXCEEDING 30]
NOTE: A STRUCTURE INCLUDES A PUMP OR ANY COMBINATION OF A PIPE, WEIR, AND BLEEDER
3
*********** STRUCTURE 1**********************
IS STRUCTURE NO. 1 A PUMP?
1 = YES   2 = NO
1.


***** ENTER PUMP INFORMATION STRUCTURE
ENTER ELEVATION AT WHICH PUMP TURNS ON (FT)
18.
ENTER ELEVATION AT WHICH PUMP TURNS OFF (FT)
NOTE: PUMPOFF ELEVATION MUST BE HIGHER THAN THE
  LOWEST STAGE OF THE STAGE STORAGE CURVE
17.5
ENTER PUMP DISCHARGE CAPACITY (CFS OR GPM)
DISCHARGE CAPACITY MAY BE ENTERED IN EITHER CFS OR GPM
6.
ENTER 1 - IF DISCHARGE CAPACITY ENTERED IN CFS
      2 - IF DISCHARGE CAPACITY ENTERED IN GPM
1
DO YOU WISH TO CORRECT PUMP INFORMATION?
 1=YES  2=NO
2.
NOTE: "OFFSITE" BASIN IS DESIGNATED AS BASIN NO.   3
ENTER BASIN NUMBERS
STRUCTURE  1 DISCHARGES FROM BASIN NO.(_) TO BASIN NO/.(_)
1 2
*********** STRUCTURE 2**********************
IS STRUCTURE NO. 2 A PUMP?
1 = YES   2 = NO
2.
DOES STRUCTURE NO. 2 HAVE A PIPE?
1 = YES   2 = NO
1.
ENTER DIAMETER(FT) ,ROUGHNESS(MANNING S N), PIPE LENGTH(FT)

1.5 .024 50.
ENTER PIPE HEAD INVERT ELEVATION, TAIL INVERT ELEVATION
18.1 18.1
DOES STRUCTURE HAVE A FLASH BOARD RISER OR A WEIR
ANSWER NO IF THE RISER HAS A BLEEDER ONLY
 1=YES  2=NO
1.
IS THE WEIR  1. BROAD CRESTED , OR 2. SHARP CRESTED ?
ENTER 1, 2 OR 3
3.
ENTER WIER CREST ELEVATION AND RADIUS
23.6 1.5
DOES THIS STRUCTURE HAVE A BLEEDER
1-YES  2-NO
2.
```

```
NOTE: "OFFSITE" BASIN IS DESIGNATED AS BASIN NO.   3
ENTER BASIN NUMBERS
STRUCTURE  2 DISCHARGES FROM BASIN NO.(_) TO BASIN NO/.(_)
2 1
*********** STRUCTURE 3*********************
IS STRUCTURE NO.  3 A PUMP?
1 = YES   2 = NO
2.
DOES STRUCTURE NO.  3 HAVE A PIPE?
1 = YES   2 = NO
1.
ENTER DIAMETER(FT) ,ROUGHNESS(MANNING S N), PIPE LENGTH(FT)

2. .024 50.
ENTER PIPE HEAD INVERT ELEVATION, TAIL INVERT ELEVATION
18.1 18.1
DOES STRUCTURE HAVE A FLASH BOARD RISER OR A WEIR
ANSWER NO IF THE RISER HAS A BLEEDER ONLY
 1=YES  2=NO
1.
IS THE WEIR  1. BROAD CRESTED , OR 2. SHARP CRESTED ?
ENTER 1, 2 OR 3
2.
ENTER WIER CREST ELEVATION AND LENGTH
23. 1.
DOES THIS STRUCTURE HAVE A BLEEDER
1-YES  2-NO
1.
ENTER TYPE OF BLEEDER:
   1= V-NOTCH , 2 = CIRCULAR ORFICE, 3 = RECTANGULAR ORIFICE
1.
ENTER V-NOTCH INVERT ELEVATION(FT-NGVD), TOP ELEVATION(FT-NGVD), AND ANGLE(DEGREES)
20.1 20.9 50.
NOTE: "OFFSITE" BASIN IS DESIGNATED AS BASIN NO.   3
ENTER BASIN NUMBERS
STRUCTURE  3 DISCHARGES FROM BASIN NO.(_) TO BASIN NO/.(_)
2 3



ENTER TIME VARYING OUTFALL STAGE
ENTER TIME(IN HOURS), STAGE AT THAT TIME (FT.NGVD)
ONE SET OF (TIME, STAGE) IS ONE ENTRY,MAX 100 ENTRIES

NOTE: THE FIRST ENTRY SHOULD BE FOR TIME 0.0

      THE LAST ENTRY SHOULD BE A TIME LARGER THAN THE
      ROUTING TIME, AND THE NORMAL OFFSITE STAGE

      THE LAST DATA ENTRY MUST BE FOLLOWED BY A
      0,0 ENTRY

      IF THE OFFSITE STAGE IS CONSTANT MAKE AN ENTRY
```

```
     FOR T = 0.0 AND FOR T = 1000. HR USING THE SAME
     CONSTANT STAGE INPUT FOR EACH
0. 18.1
1000. 18.1
0. 0.
DO YOU NEED TO CORRECT STRUCTURE INFORMATION?
 1=YES  2=NO
2.
```

APPENDIX B

EXAMPLE MODEL OUTPUT

SANTA BARBARA METHOD USED FOR ROUTING

PROJECT NAME . . . . : CHIPCO GROVE
REVIEWER . . . . : CHINFATT
PROJECT NUMBER - 2257

THE ROUTING IS COMPLETE WHEN THE DISCHARGE FOR BASIN 2 IS REDUCED TO 1.80CFS

********************** BASIN 1 *****************

AREA - 66.40 ACRES GROUND STORAGE - 0.50 INCHES

TIME STEP - 4.00 HOURS TIME OF CONCENTRATION - 0.70 HOURS

RETURN FREQUENCY - 25.00 YEARS RAINFALL DISTRIBUTION : 3- DAY 24-HOUR RAINFALL - 6.80 INCHES

STAGE (FT)	STORAGE (AF)
17.00	0.00
19.00	4.00
20.00	12.60
22.00	140.40

********************** BASIN 2 *****************

AREA - 12.00 ACRES GROUND STORAGE - 0.01 INCHES

TIME STEP - 4.00 HOURS TIME OF CONCENTRATION - 0.70 HOURS

RETURN FREQUENCY - 25.00 YEARS RAINFALL DISTRIBUTION : 3- DAY 24-HOUR RAINFALL - 6.80 INCHES

STAGE (FT)	STORAGE (AF)
20.10	0.00
21.10	10.00
22.10	22.00
23.10	34.00
24.10	46.00
25.10	58.00

DISCHARGE STRUCTURE INFORMATION

STRUCT NO.	PIPE SLOPE (%)	DIAMETER (FT)	ROUGHNESS	LENGTH (FT)	WEIR WEIR CREST TYPE/ELEV	WEIR LENGTH	HEAD INVERT ELEVATION	TAIL INVERT ELEVATION	
1	STRUCTURE IS A PUMP; SEE PUMP TABLE								
2	0.000	1.5	0.024	50.00	DROP / 23.60	9.42	18.10	18.10	BASIN 2 TO BASIN 1
3	0.000	2.0	0.024	50.00	SHARP/ 23.00	1.00	18.10	18.10	BASIN 2 TO BASIN 3

BLEEDER INFORMATION

STRUCT NO.	BLEEDER TYPE	ORIFICE DIAMETER OR WIDTH (FT)	ORIFICE INVERT ELEVATION (FT-NGVD)	ORIFICE AREA (FT2)	V-NOTCH ANGLE (DEG)	V-NOTCH INVERT ELEVATION (FT-NGVD)	TOP ELEVATION (FT-NGVD)
1	NO BLEEDER INCLUDED IN STRUCTURE						
2	NO BLEEDER INCLUDED IN STRUCTURE						
3	V-NOTCH	NA	NA	NA	50.0	20.1	20.9

PUMP TABLE

PUMP NO.	PUMP ON ELEVATION (FEET)	PUMP OFF ELEVATION (FEET)	PUMP DISCHARGE (GPM)	DISCHARGES FROM BASIN	TO BASIN
1	18.00	17.50	2692.80	1	2

OFFSITE RECEIVING WATER

TIME(HR)	STAGE(FT-NGVD)
0.00	18.10
1000.00	18.10

SUMMARY REPORT

TIME (HR)	STRUCT NO	BASIN NO	CUMULATIVE RAINFALL (INCHES)	CUMULATIVE RUNOFF (INCHES)	INSTANT. RUNOFF (CFS)	RUNOFF HYDROGRAPH (CFS)	DISCHARGE (CFS)	INSTANT. STAGE (FT)	FROM	TO	STRUCTURE CONTROL
0.0	1	1	0.0	0.0	0.0	0.0	0.00	17.00	1	2	
	2	2	0.0	0.0	0.0	0.0	0.00	20.10	2	1	
	3	2	0.0	0.0	0.0	0.0	0.00	20.10	2	3	
4.0	1	1	0.2	0.0	0.6	0.4	0.00	17.01	1	2	PUMP
	2	2	0.2	0.2	0.5	0.5	0.00	20.11	2	1	NO FLOW
	3	2	0.2	0.2	0.5	0.5	0.00	20.11	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
8.0	1	1	0.3	0.1	1.5	1.4	0.00	17.16	1	2	PUMP
	2	2	0.3	0.3	0.5	0.5	0.00	20.13	2	1	NO FLOW
	3	2	0.3	0.3	0.5	0.5	0.00	20.13	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
12.0	1	1	0.5	0.2	1.9	1.8	0.00	17.43	1	2	PUMP
	2	2	0.5	0.5	0.5	0.5	0.00	20.15	2	1	NO FLOW
	3	2	0.5	0.5	0.5	0.5	0.00	20.15	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
16.0	1	1	0.7	0.3	2.2	2.1	0.00	17.76	1	2	PUMP
	2	2	0.7	0.7	0.5	0.5	0.00	20.16	2	1	NO FLOW
	3	2	0.7	0.7	0.5	0.5	0.00	20.16	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
PUMP 1 "ON " AT 18.67 HOURS											
20.0	1	1	0.8	0.4	2.3	2.3	6.00	17.79	1	2	PUMP
	2	2	0.8	0.8	0.5	0.5	0.00	20.24	2	1	NO FLOW
	3	2	0.8	0.8	0.5	0.5	0.01	20.24	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
PUMP 1 "OFF" AT 21.95 HOURS											
24.0	1	1	1.0	0.6	2.4	2.4	0.00	17.70	1	2	PUMP
	2	2	1.0	1.0	0.5	0.5	0.00	20.36	2	1	NO FLOW
	3	2	1.0	1.0	0.5	0.5	0.04	20.36	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
PUMP 1 "ON " AT 26.28 HOURS											
28.0	1	1	1.2	0.8	3.7	3.6	6.00	17.83	1	2	PUMP

SUMMARY REPORT

TIME (HR)	STRUCT NO	BASIN NO	CUMULATIVE RAINFALL (INCHES)	CUMULATIVE RUNOFF (INCHES)	INSTANT. RUNOFF (CFS)	RUNOFF HYDROGRAPH (CFS)	DISCHARGE (CFS)	INSTANT. STAGE (FT)	FROM	TO	STRUCTURE CONTROL
	2	2	1.2	1.2	0.7	0.7	0.00	20.46	2	1	NO FLOW
	3	2	1.2	1.2	0.7	0.7	0.09	20.46	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
PUMP 1 "OFF" AT 31.48 HOURS											
32.0	1	1	1.5	1.0	3.8	3.7	0.00	17.58	1	2	PUMP
	2	2	1.5	1.5	0.7	0.7	0.00	20.65	2	1	NO FLOW
	3	2	1.5	1.5	0.7	0.7	0.27	20.65	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
PUMP 1 "ON " AT 34.72 HOURS											
36.0	1	1	1.7	1.2	3.8	3.8	6.00	17.88	1	2	PUMP
	2	2	1.7	1.7	0.7	0.7	0.00	20.73	2	1	NO FLOW
	3	2	1.7	1.7	0.7	0.7	0.37	20.73	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
40.0	1	1	2.0	1.5	3.9	3.9	6.00	17.53	1	2	PUMP
	2	2	2.0	1.9	0.7	0.7	0.00	20.94	2	1	NO FLOW
	3	2	2.0	1.9	0.7	0.7	0.79	20.94	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
PUMP 1 "OFF" AT 40.30 HOURS											
PUMP 1 "ON " AT 43.45 HOURS											
44.0	1	1	2.2	1.7	3.9	3.9	6.00	17.95	1	2	PUMP
	2	2	2.2	2.2	0.7	0.7	0.00	20.98	2	1	NO FLOW
	3	2	2.2	2.2	0.7	0.7	0.84	20.98	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
48.0	1	1	2.4	1.9	3.9	3.9	6.00	17.61	1	2	PUMP
	2	2	2.4	2.4	0.7	0.7	0.00	21.16	2	1	NO FLOW
	3	2	2.4	2.4	0.7	0.7	1.04	21.16	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
PUMP 1 "OFF" AT 49.45 HOURS											
PUMP 1 "ON " AT 51.93 HOURS											
52.0	1	1	2.7	2.2	6.2	5.7	6.00	18.00	1	2	PUMP
	2	2	2.7	2.7	1.2	1.1	0.00	21.21	2	1	NO FLOW
	3	2	2.7	2.7	1.2	1.1	1.09	21.21	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											

SUMMARY REPORT

TIME (HR)	STRUCT NO	BASIN NO	CUMULATIVE RAINFALL (INCHES)	CUMULATIVE RUNOFF (INCHES)	INSTANT. RUNOFF (CFS)	RUNOFF HYDROGRAPH (CFS)	DISCHARGE (CFS)	INSTANT. STAGE (FT)	FROM	TO	STRUCTURE CONTROL
56.0	1	1	3.4	2.8	13.4	12.5	6.00	18.50	1	2	PUMP
	2	2	3.4	3.4	2.5	2.3	0.00	21.39	2	1	NO FLOW
	3	2	3.4	3.4	2.5	2.3	1.25	21.39	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
60.0	1	1	6.9	6.3	305.4	171.0	6.00	19.81	1	2	PUMP
	2	2	6.9	6.9	55.5	31.1	0.00	21.67	2	1	NO FLOW
	3	2	6.9	6.9	55.5	31.1	1.46	21.67	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
64.0	1	1	8.4	7.9	13.6	15.0	6.00	20.22	1	2	PUMP
	2	2	8.4	8.4	2.5	2.7	0.00	22.06	2	1	NO FLOW
	3	2	8.4	8.4	2.5	2.7	1.71	22.06	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
68.0	1	1	8.9	8.3	8.2	8.2	6.00	20.24	1	2	PUMP
	2	2	8.9	8.9	1.5	1.5	0.00	22.22	2	1	NO FLOW
	3	2	8.9	8.9	1.5	1.5	1.81	22.22	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
72.0	1	1	9.2	8.7	5.2	5.5	6.00	20.24	1	2	PUMP
	2	2	9.2	9.2	0.9	1.0	0.00	22.37	2	1	NO FLOW
	3	2	9.2	9.2	0.9	1.0	1.89	22.37	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
76.0	1	1	9.2	8.7	0.0	0.0	6.00	20.21	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.48	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	1.95	22.48	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
80.0	1	1	9.2	8.7	0.0	0.0	6.00	20.18	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.60	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.01	22.60	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
84.0	1	1	9.2	8.7	0.0	0.0	6.00	20.15	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.70	2	1	NO FLOW

SUMMARY REPORT

TIME (HR)	STRUCT NO	BASIN NO	CUMULATIVE RAINFALL (INCHES)	CUMULATIVE RUNOFF (INCHES)	INSTANT. RUNOFF (CFS)	RUNOFF HYDROGRAPH (CFS)	DISCHARGE (CFS)	INSTANT. STAGE (FT)	FROM	TO	STRUCTURE CONTROL
	3	2	9.2	9.2	0.0	0.0	2.07	22.70	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
88.0	1	1	9.2	8.7	0.0	0.0	6.00	20.12	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.81	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.12	22.81	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
92.0	1	1	9.2	8.7	0.0	0.0	6.00	20.09	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.92	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.17	22.92	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
96.0	1	1	9.2	8.7	0.0	0.0	6.00	20.06	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	23.02	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.23	23.02	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											
100.0	1	1	9.2	8.7	0.0	0.0	6.00	20.02	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	23.12	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.40	23.12	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											
104.0	1	1	9.2	8.7	0.0	0.0	6.00	19.95	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	23.22	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.63	23.22	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											
108.0	1	1	9.2	8.7	0.0	0.0	6.00	19.72	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	23.31	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.89	23.31	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											
112.0	1	1	9.2	8.7	0.0	0.0	6.00	19.49	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	23.39	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	3.15	23.39	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											

SUMMARY REPORT

TIME (HR)	STRUCT NO	BASIN NO	CUMULATIVE RAINFALL (INCHES)	CUMULATIVE RUNOFF (INCHES)	INSTANT. RUNOFF (CFS)	RUNOFF HYDROGRAPH (CFS)	DISCHARGE (CFS)	INSTANT. STAGE (FT)	FROM	TO	STRUCTURE CONTROL
116.0	1	1	9.2	8.7	0.0	0.0	6.00	19.26	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	23.47	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	3.41	23.47	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											
120.0	1	1	9.2	8.7	0.0	0.0	6.00	19.03	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	23.53	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	3.67	23.53	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											
124.0	1	1	9.2	8.7	0.0	0.0	6.00	18.14	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	23.59	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	3.91	23.59	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											
PUMP 1 "OFF" AT 126.61 HOURS											
128.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	23.59	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	3.89	23.59	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											
132.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	23.49	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	3.50	23.49	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											
136.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	23.40	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	3.17	23.40	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											
140.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	23.31	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.90	23.31	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											
144.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP

SUMMARY REPORT

TIME (HR)	STRUCT NO	BASIN NO	CUMULATIVE RAINFALL (INCHES)	CUMULATIVE RUNOFF (INCHES)	INSTANT. RUNOFF (CFS)	RUNOFF HYDROGRAPH (CFS)	DISCHARGE (CFS)	INSTANT. STAGE (FT)	FROM	TO	STRUCTURE CONTROL
	2	2	9.2	9.2	0.0	0.0	0.00	23.24	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.68	23.24	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											
148.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	23.17	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.50	23.17	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											
152.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	23.10	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.35	23.10	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											
156.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	23.04	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.25	23.04	2	3	WEIR
OFFSITE STAGE IS 18.10 FT.NGVD											
160.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.97	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.20	22.97	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
164.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.91	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.17	22.91	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
168.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.86	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.14	22.86	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
172.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.80	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.11	22.80	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											

SUMMARY REPORT

TIME (HR)	STRUCT NO	BASIN NO	CUMULATIVE RAINFALL (INCHES)	CUMULATIVE RUNOFF (INCHES)	INSTANT. RUNOFF (CFS)	RUNOFF HYDROGRAPH (CFS)	DISCHARGE (CFS)	INSTANT. STAGE (FT)	FROM	TO	STRUCTURE CONTROL
176.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.74	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.08	22.74	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
180.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.68	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.06	22.68	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
184.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.63	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.03	22.63	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
188.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.57	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	2.00	22.57	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
192.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.52	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	1.97	22.52	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
196.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.46	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	1.94	22.46	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
200.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.41	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	1.91	22.41	2	3	BLEEDER
OFFSITE STAGE IS 18.10 FT.NGVD											
204.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.36	2	1	NO FLOW

SUMMARY REPORT

TIME (HR)	STRUCT NO	BASIN NO	CUMULATIVE RAINFALL (INCHES)	CUMULATIVE RUNOFF (INCHES)	INSTANT. RUNOFF (CFS)	RUNOFF HYDROGRAPH (CFS)	DISCHARGE (CFS)	INSTANT. STAGE (FT)	FROM	TO	STRUCTURE CONTROL
	3	2	9.2	9.2	0.0	0.0	1.88	22.36	2	3	BLEEDER

OFFSITE STAGE IS 18.10 FT.NGVD

208.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.30	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	1.86	22.30	2	3	BLEEDER

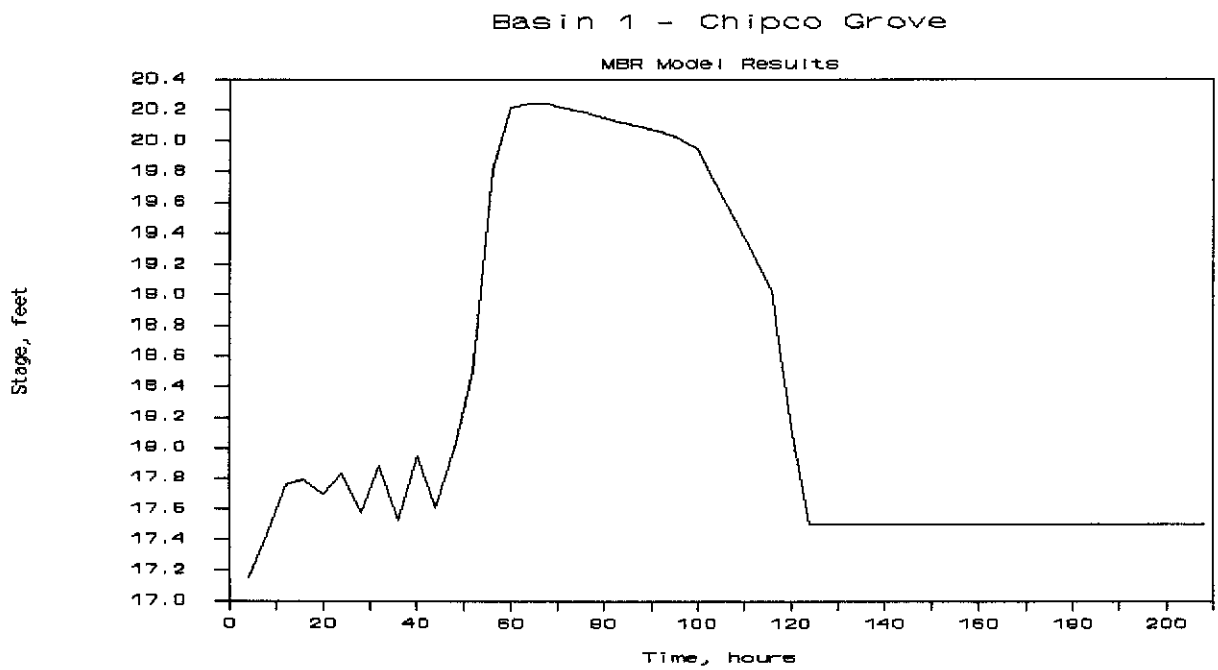
OFFSITE STAGE IS 18.10 FT.NGVD

212.0	1	1	9.2	8.7	0.0	0.0	0.00	17.50	1	2	PUMP
	2	2	9.2	9.2	0.0	0.0	0.00	22.25	2	1	NO FLOW
	3	2	9.2	9.2	0.0	0.0	1.83	22.25	2	3	BLEEDER

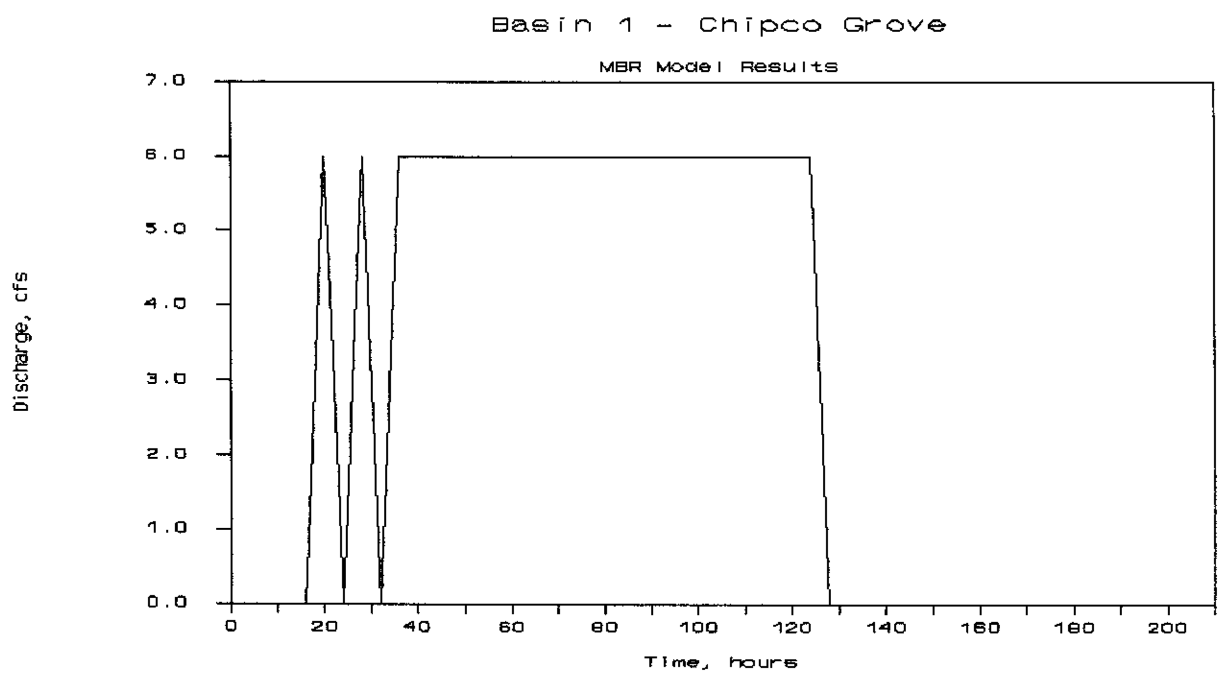
OFFSITE STAGE IS 18.10 FT.NGVD

STRUCTURE NO.	PEAK DISCHARGE (CFS)	TIME OF QPEAK	PEAK STAGE (FT-NGVD)	TIME OF HPEAK
1	6.0	18.7	20.2	69.1
2	0.2	126.6	23.6	126.6
3	4.1	126.6	23.6	126.6

BASIN NO.	TOTAL INFLOW (AC-FT)	TOTAL RUNOFF (AC-FT)	TOTAL OUTFLOW (AC-FT)	FINAL TIME (HOURS)	FINAL STAGE (FT-NGVD)	FINAL STORAGE (AC-FT)
1	15.81	47.96	34104.00	215.92	17.50	1.00
2	34104.00	9.23	23917.50	215.92	22.20	23.26

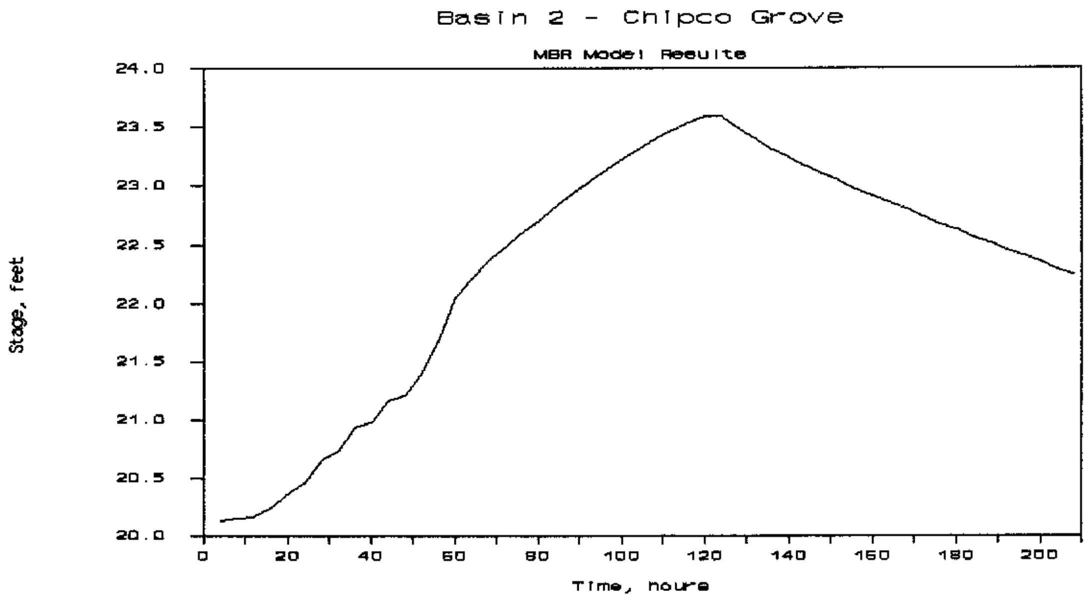


a. Plot of computed stage.

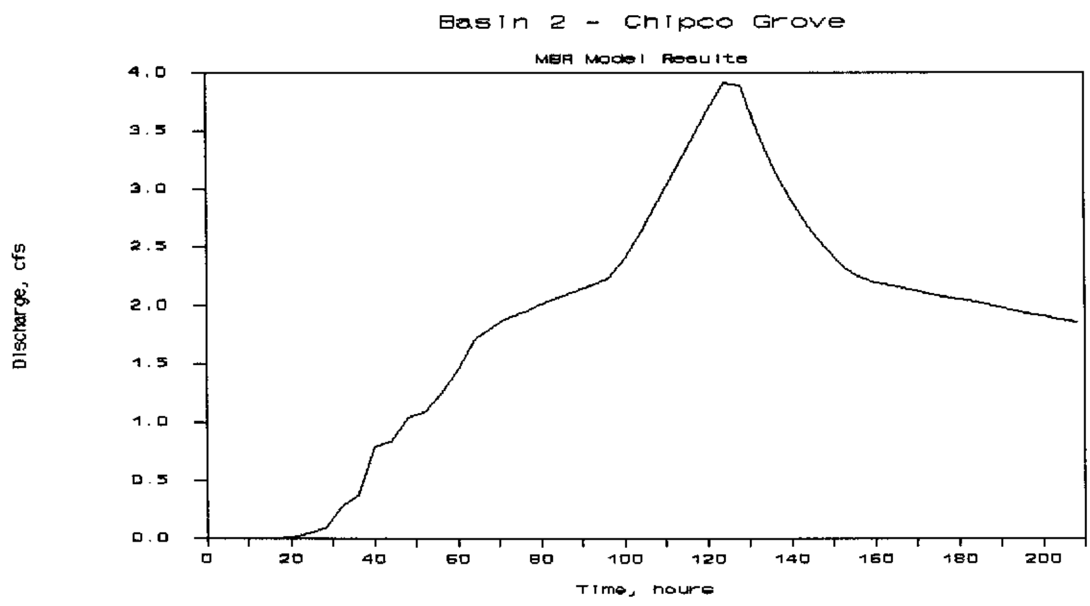


b. Plot of computed discharge.

Figure B-1. Model results for Basin 1 of the Chipco Grove example.



a. Plot of computed stage.



b. Plot of computed discharge.

Figure B-2. Model results for Basin 2 of the Chipco Grove example.

APPENDIX C

USER INSTRUCTIONS

MULTIBASIN ROUTING (MBR) MODEL
USER GUIDELINES

THIS MODEL COMPUTES, AT SPECIFIED TIME INTERVALS,
* FLOW BETWEEN ADJACENT BASINS THROUGH INTERCONNECTING STRUCTURES
* STAGE ELEVATIONS IN EACH BASIN
UNTIL A PREDETERMINED STAGE IN A CONTROLLING BASIN IS EXCEEDED

THE INTERCONNECTING STRUCTURES MAY BE EITHER A PUMP OR ANY COMBINATION OF PIPE, WEIR AND BLEEDER.

.***** THIS MODEL MUST ALWAYS BE RUN IN A SUBDIRECTORY NAMED MBRDIR.
.***** THIS IS THE DEFAULT DIRECTORY IN WHICH ALL INPUT/OUTPUT FILES
.***** WILL BE STORED.

THE EXECUTION STATEMENT FOR THE MODEL IS:

```
> A: ROUTEMOD  OPT1  OPT2  OPT3
```

OPT1 = AN INTEGER WHICH SPECIFIES THE TYPE OF RUN
1 SPECIFIES A MODEL RUN USING AN EXISTING INPUT DATA FILE THIS DATA FILE MUST EXIST IN THE DEFAULT DIRECTORY
2 SPECIFIES AN INTERACTIVE MODEL RUN IN WHICH THE DATA IS ENTERED FROM THE KEYBOARD IN RESPONSE TO PROMPTS FROM THE SCREEN. A DATA FILE IS CREATED WHICH MAY BE USED FOR SUBSEQUENT TYPE 1 RUNS.
3 ALLOWS THE USER TO CREATE A DATA FILE INTERACTIVELY FOR LATER USE IN TYPE 1 MODEL RUNS.

OPT2 = A FILENAME (NO EXTENSION) IN WHICH INPUT DATA IS EITHER STORED OR, IN THE CASE OF INTERACTIVE DATA ENTRY, WRITTEN. THIS FILE EXISTS/IS CREATED IN THE DEFAULT DIRECTORY. AN EXTENSION .DAT IS AUTOMATICALLY APPLIED TO THE FILENAME PROVIDED BY THE USER.

OPT3 = THE NAME OF THE OUTPUT FILENAME (NO EXTENSION) IN WHICH THE MODEL RESULTS ARE TO BE WRITTEN. THIS FILE IS CREATED IN THE DEFAULT DIRECTORY. AN EXTENSION .DAT IS AUTOMATICALLY APPLIED TO THE FILENAME PROVIDED BY THE USER.

FOR MODEL RUNS TYPES 1 AND 2 A RECORD OF THE DATA ENTRY SESSION IS KEPT IN A FILE CALLED RUNFIL.DAT. THIS FILE IS CREATED IN THE DEFAULT DIRECTORY. FOR INFORMATION ABOUT DATA INPUTS REQUIRED BY THE MODEL, REFER TO THE USER'S MANUAL.

.PLOTTING

THE RESULTS OF THE MODEL CAN BE PLOTTED BY TYPING

```
> A:PLOT
```

```
A DATA FILE CALLED PLTFIL.DAT IS AUTOMATICALLY CREATED BY THE MBR
MODEL FOR PLOTTING RESULTS.
IF YOU WISH TO SAVE THIS FILE, RENAME IT AS FOLLOWS

> RENAME PLTFIL.DAT newname.DAT

OTHERWISE, THIS FILE WILL BE WRITTEN OVER THE NEXT TIME ROUTEMOD
IS RUN.
IT SHOULD BE NOTED HOWEVER, THAT THE PLOT ROUTINE APPLIES ONLY TO A DATA
FILE CALLED PLTFIL.DAT

IF YOU HAVE NOT USED THIS PLOTTING ROUTINE BEFORE, PLEASE TYPE

> A:HELPLOT

FOR MORE INSTRUCTIONS
.
.SUMMARY
.
TO RUN MODEL
> A: ROUTEMOD OPT1  OPT2  OPT3
.
TO PLOT RESULTS
> A:PLOT

                    HAPPY TRAILS!!!!!
              ******************************
?
```

MULTIBASIN ROUTING (MBR) MODEL
USER GUIDELINES FOR PLOTTING RESULTS

THIS PROGRAM MUST BE RUN IN A SUBDIRECTORY CALLED MBRDIR !!!!!

THE MODEL, ROUTEMOD, CREATES AN OUTPUT FILE CALLED PLTFIL.DAT WHICH CAN BE USED FOR PLOTTING STAGE vs TIME AND OUTFLOW FROM THE BASIN (DISCHARGE) vs. TIME FOR ANY SELECTED BASIN.

THIS CAN BE DONE BY TYPING

> A:PLOT

THE " A:PLOT " ROUTINE LOOKS FOR AN EXISTING FILE NAMED PLTFIL.DAT, IN THE SUBDIRECTORY MBRDIR, SELECTS DATA APPLICABLE TO THE SPECIFIED BASIN AND EXITS AUTOMATICALLY TO "SYMPHONY" TO DO THE PLOT. THE PLOT IS THEN DONE BY ENTERING THE FOLLOWING:

F9
F
R
Esc.
Esc.
A:\
Return
Return

THE USER WILL THEN BE PROMPTED AT THE TOP OF THE SCREEN FOR A PLOT TITLE ENTER THE PLOT TITLE AND THEN, Return.

IF YOU WISH TO SAVE THE FILE, PLTFIL.DAT, RENAME IT AS FOLLOWS

> RENAME PLTFIL.DAT newname.DAT

OTHERWISE, THIS FILE WILL BE WRITTEN OVER THE NEXT TIME ROUTEMOD IS RUN.
IT SHOULD BE NOTED HOWEVER, THAT THE PLOT ROUTINE APPLIES ONLY TO A DATA FILE CALLED PLTFIL.DAT

.SUMMARY

TO PLOT RESULTS
> A:PLOT

F9
F
R
Esc.
Esc.
A:\
Return
Return
: plot title

HAPPY TRAILS!!!!!

****

?